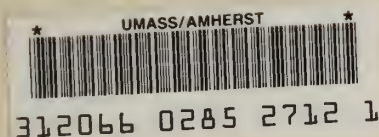


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## EXECUTIVE SUMMARY

### CAPE COD RAILROAD PROJECT

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presented to the

**Executive Office of  
Transportation and Construction**

by

**Parsons Brinckerhoff Quade & Douglas, Inc.**

in association with

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Lozano, White & Associates

Charles River Associates, Inc.

Bryant Associates, Inc.

Boston, Massachusetts

December 1980



## **EXECUTIVE SUMMARY**

### INTRODUCTION

This report, performed under contract with the Massachusetts Bay Transportation Authority (MBTA) for the Executive Office of Transportation and Construction, represents the first phase of the effort to restore rail passenger service from Hyannis and Falmouth on Cape Cod to New York and Boston. It consists of five primary elements:

- An inventory of existing track, signals, and bridges to determine reconstruction requirements for upgrading the rail network to Class 3 service (59 mph),
- An analysis of patronage and operational requirements,
- A determination of equipment requirements,
- An analysis of layover facility and maintenance facility needs, and
- An outline of the environmental factors which will have to be addressed in continuing project phases.

Four alternative routes were investigated. These routes follow existing track or right-of-way currently owned by Conrail or the MBTA. The Cape Cod - New York route has one possible alignment, while three alternative routes are identified as capable of providing service between Cape Cod and Boston. In all cases, rail service to and from Cape Cod includes terminal stations at both Hyannis and Falmouth.

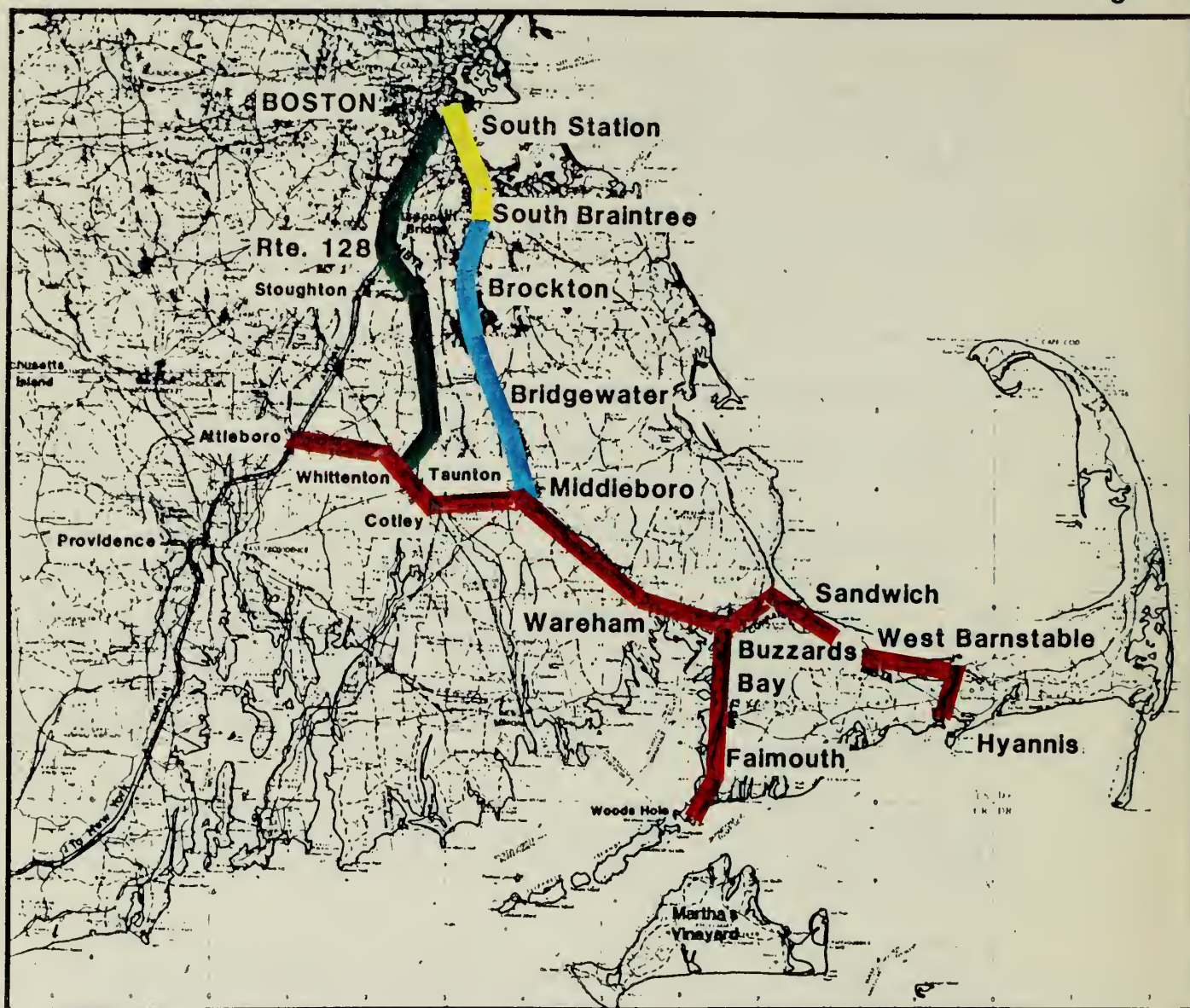
The Cape Cod - New York route, designated Line A, proceeds from Hyannis and Falmouth through Buzzards Bay, Middleboro, and Taunton to Attleboro, where it meets with Amtrak's existing New York - Boston Northeast Corridor service.

Of the three possible alignments to Boston, the first provides service from the Cape Cod terminals through Brockton to South Braintree, the present terminal station on the MBTA's Red Line rapid transit service. This is termed Line B.

The other two Boston routes each connect Hyannis and Falmouth with South Station. One extends from the Cape Cod terminals through Buzzards Bay, Middleboro, and Taunton then proceeds northward through Stoughton to Canton Junction. At Canton Junction it joins with Amtrak's Northeast Corridor route to South Station. The second Cape Cod to South Station scheme follows the route of Line B from Hyannis and Falmouth to South Braintree where new track is required to take it through the suburbs and city of Boston to South Station. These alternatives are designated Lines C(1) and C(2), respectively. Figure 1 shows each of the alignments studied.

The following sections present summary findings of each element included in this analysis.

Figure 1



## Cape Cod Railroad Project

- Line A: Cape Cod to Attleboro
- Line B: Middleboro to Braintree
- Line C(1): Whittenton to South Station via Canton Junction
- Line C(2): South Braintree to South Station

## KEY FINDINGS

This summary presents aggregate findings for the Cape Cod to New York service alone and for the New York service coupled with each of the three alternative alignments for providing service from the Cape to Boston, to allow for comparison among the schemes. In all cases, substantial capital expenditures are required in order to upgrade track, signals, bridges, and stations and to provide layover and maintenance facilities. Rolling stock acquisitions are necessary for all schemes.

Among the individual lines, rail service between Cape Cod and New York (Line A) has the lowest operating deficit, ridership, capital expenditures, and maintenance costs. Of the Boston alternatives, the lowest annual operating deficit is for Line B, from Cape Cod to South Braintree. The greatest ridership is achieved between Hyannis, Falmouth, and South Station via South Braintree (Line C(2)).

Rail service to New York and South Braintree (Lines A and B) has the lowest capital expenditure requirements and the lowest annual maintenance costs among the three Boston service alternatives. It also has the least annual operating loss, while carrying the second greatest number of passengers.

The combination of New York service and service to South Station via Canton Junction (Lines A and C(1)) has the lowest projected ridership and the highest annual operating loss. Capital expenditures and maintenance costs are the second highest among the schemes.

Providing rail service from Cape Cod to New York and South Station via South Braintree (Lines A and C(2)) results in the highest ridership, capital costs, and maintenance costs. The anticipated annual operating loss is the second largest.

Table 1-1 illustrates annual subsidy requirements (including annual operating deficit and maintenance costs), patronage and capital costs associated with each of the various alternatives.

Table 1-1  
COMPARISON AMONG RAIL LINES  
(1980 Dollars)

	<u>Annual Subsidy Requirement*</u>	<u>Annual Patronage</u>	<u>Capital Expenditures</u>
Cape Cod to New York	\$2,075,400	70,581	\$36,981,000
Cape Cod to S. Braintree	3,792,340	510,036	42,806,000
Cape Cod to S. Station via Canton Jct.	4,645,180	352,188	50,706,000

Cape Cod to S. Station via S. Braintree	4,079,640	623,203	61,012,000
Cape Cod to New York and S. Braintree	4,742,500	580,617	56,464,000
Cape Cod to New York and S. Station via Canton Jct.	5,597,100	422,769	62,589,000
Cape Cod to New York and S. Station via S. Braintree	5,047,800	693,784	75,033,000

\* Includes annual operating loss and average annual maintenance costs (including track, signals, bridges, and stations). Operating deficit is the difference between revenues and costs with push-pull equipment.

#### TRACK

All of the existing track along each of the lines was evaluated during field surveys. A mile-by-mile graphic description of existing conditions was prepared, and a summary of conditions and recommendations presented.

Each segment of track is presented according to ownership and use, track condition, recommendations, and cost estimates.

Recommended improvements include selected replacement of rail cross ties, switch ties, turnouts, and rail anchors; rehabilitation of grade crossings, roadbed shoulders and drainage ditches; and ballasting, tamping, surfacing, and aligning of the track throughout.

Total preliminary capital cost requirements to achieve Class 3 service for the various lines are as follows, all in fourth quarter 1980 dollars.

● Cape Cod to New York (Line A)	\$20,830,000
● Cape Cod to New York and South Braintree (Lines A & B)	23,809,000
● Cape Cod to New York and South Station via Canton Junction (Lines A & C(1))	30,794,000
● Cape Cod to New York and South Station via South Braintree (Lines A & C(2))	27,801,000

#### SIGNALS

A condition survey was performed of the existing signal network for each of the various lines.

The survey was based on Conrail's existing circuit drawings and plans and on site inspection of existing interlockings and a sampling of highway crossing protection.

Recommendations and preliminary construction cost estimates were prepared based upon two signal systems, one a "minimum" signal system designed to meet all safety requirements and a second for a more costly but higher level facility, referred to as a "desirable" system. The minimum signal system modifications and construction work are based upon manual block operating rules south of Middleboro.

The work recommended for the desirable system includes the installation of an automatic block and traffic control system in all the territory not presently operated under traffic control rules.

The highway crossing improvements, which are the same under either system, provide for the relocation of existing starts to accomodate the proposed 59 mph speeds, except through Taunton where it is expected that existing speed restrictions will apply. Where flashers or flashers and gates presently exist, no further protection is recommended except for south of Buzzards Bay where both gates and flasher will be provided at all public crossings. All private and farm crossings will remain without automatic protection.

Preliminary capital costs for the minimum signal system, in 1980 dollars, are as follows:

• Cape Cod to New York (Line A)	\$1,887,000
• Cape Cod to New York and South Braintree (Lines A & B)	2,593,000
• Cape Cod to New York and South Station via Canton Junction (Lines A & C(1))	3,527,000
• Cape Cod to New York and South Station via South Braintree (Lines A & C(2))	3,558,000

#### BRIDGES

A field survey was conducted of all undergrade bridges to observe the extent of any defects or deterioration in the structures; to determine repairs or replacements necessary; and to develop cost estimates for appropriate repairs and replacements.

An inventory of existing bridges was obtained from Conrail's computer list of structures. A total of fifty-six bridges appeared, as well as twenty-eight culverts and cattle passes. Because the minor culverts inspected were in satisfactory condition, other smaller culverts appearing on the railroad track chart were excluded from the inspection.

The actual field inspection consisted of examining all visible and accessible portions of the existing structures. Inspection was limited to above grade and above waterline structural members and to those parts of each structure which were accessible without the use of scaffolding or boats and which did not require the removal of existing materials.

Two designations have been used to define recommendations: Stage 1 repairs include those items critical to the continued use of the structure and to repairs which require moving track or which would otherwise disrupt service if delayed until after restoration of passenger service. Stage 2 repairs are maintenance items which may be deferred for up to five years.

Total preliminary capital cost requirements for bridges are as follows, all in fourth quarter 1980 dollars.

	<u>Stage 1 Repairs</u>
• Cape Cod to New York (Line A)	\$ 2,284,200
• Cape Cod to New York and South Braintree (Lines A & B)	2,780,500
• Cape Cod to New York and South Station via Canton Junction (Lines A & C(1))	2,571,800
• Cape Cod to New York and South Station via South Braintree (Lines A & C(2))	14,547,900

#### STATIONS

Of the seventeen stations visited and analyzed, eleven were selected based on projected travel demand to service the Cape Cod Railroad Project. Between Hyannis, Falmouth, and Middleboro are seven stations: Hyannis, Falmouth, West Barnstable, Sandwich, Buzzards Bay, Wareham and Middleboro. Line A requires no additional stations in Massachusetts. Line B will use stations north of Middleboro at Bridgewater, Brockton, and South Braintree. Line C(1) will use only the existing Route 128 station at Canton in addition to those from Cape Cod to Middleboro, because of existing commuter rail service from Stoughton. Line C(2) will not use any stations in addition to those in Line B, except for South Station in Boston.

All of the stations except Route 128 and South Station require some upgrading in the form of graphics, lighting, plantings, parking, platform or shelter improvements, amenities for the elderly and handicapped, and the like. Preliminary cost estimates, in 1980 dollars, for station improvements are:

#### Cape Cod to New York (Line A)

Hyannis	\$ 210,585
West Barnstable	94,295
Sandwich	82,745
Falmouth	328,915
Buzzards Bay	<u>208,030</u>
Total	<u>\$ 924,570</u>

Cape Cod to New York and  
South Braintree (Lines A & B)

All New York stations	\$ 924,570
Wareham	81,745
Middleboro	148,395
Bridgewater	101,630
Brockton	211,543
South Braintree	<u>85,630</u>
Total	\$1,553,513

Cape Cod to New York and Boston  
via Canton Junction (Lines A & C(1))

All New York Stations	\$ 924,570
Wareham	81,745
Route 128	0
South Station	<u>0</u>
Total	\$1,006,315

Cape Cod to New York and Boston  
via South Braintree (Lines A & C(2))

All New York/South Braintree Stations	\$1,553,513
South Station	<u>\$ 0</u>
Total	\$1,553,513

LAYOVER AND MAINTENANCE FACILITIES

Layover and maintenance facility requirements are described for the maximum new service system: two trains from both New York and Boston of the push-pull type, which require the greatest amount of storage space.

Layover facilities are recommended for Hyannis and Falmouth to allow overnight storage of trains, fueling and sanding of equipment, and daily cleaning of the coaches and self-propelled passenger coach equipment (SPPC). A service building is included at each complex for storage of equipment and tools, and fueling and sanding sites are also needed.

Middleboro is the recommended location of the maintenance facility, due to its central location and the availability of right-of-way. This complex is equipped to perform preventive maintenance through scheduled inspections. The locomotive and coach maintenance shop has the capability to perform minor repairs, most on a unit exchange basis. Other features of the maintenance facility complex are repair-in-place tracks outside of the maintenance facility, a refueling and sanding site, an administrative and storage building, and a spare equipment storage track.

A wash facility is not recommended for this network, due to the small number of locomotives and cars required. A maintenance-of-way equipment area is also not recommended, as it is assumed that maintenance of this equipment would be performed at another location. In addition, it is assumed that major overhauls and heavy repairs will be performed at existing facilities capable of handling such activities.

A maintenance facility is required only for service to South Braintree (Line B) or the combination of Cape Cod to New York and South Braintree service (Lines A and B).

The total preliminary capital cost estimates for these three facilities in fourth quarter 1980 dollars are:

Hyannis layover facility	\$ 662,500
Falmouth layover facility	427,700
Middleboro Maintenance facility	1,036,800

#### EQUIPMENT ANALYSIS

Based on evaluations of available equipment types and system requirements, two alternative equipment types were analyzed: push-pull locomotives hauling or pushing passenger coaches and SPPC's.

Utilizing patronage forecasts developed as part of this study, equipment requirements for each alternative were determined and preliminary cost estimates prepared.

In deriving equipment requirements under the self-propelled alternative, it was assumed that SPPC's are used only for Falmouth service from Boston, as the Boston - Hyannis train consists will generally exceed three cars, the point at which push-pull service becomes more economical. For New York City service, however, the self-propelled alternative uses only SPPC's.

Based on these analyses, the self-propelled alternative requires a higher capital investment than the push-pull in every case. This result is due to two major factors. The purchase price differential between SPPC's and cab and trailer coaches is such that any train consist having more than three passenger coaches costs less with push-pull equipment. Second, each SPPC, besides carrying the normal heating ventilation, and lighting systems required for a passenger coach, also carries all the propulsion and control systems of a locomotive. Due to this complexity of systems, the frequency of repair for an SPPC is higher than that for conventional push-pull equipment, and a higher percentage of spare SPPC's is required to meet the demands of scheduled passenger service. The State of Connecticut, which operates a fleet of SPPC's, has experienced situations where 40% or more of its fleet were undergoing repair or maintenance at a given time. Preliminary equipment requirements and costs are indicated as follows:

Table 1-2  
PEAK EQUIPMENT REQUIREMENTS AND COSTS BY LINE  
 (Thousands of 1980 Dollars)

<u>Push-Pull:</u>	<u>Cape Cod to New York</u>	<u>Cape Cod to Braintree</u>	<u>Cape Cod to Boston via Canton Jct.</u>	<u>Cape Cod to Boston via S. Braintree</u>
Locomotives	2	4	4	4
Cab Coaches	2	4	4	4
Trailer Coaches	6	8	8	12
Spare Cabs	1	1	1	1
Spare Trailers	1	1	1	1
Spare Locomotives	1	1	1	1
Total Cost	\$9,800	\$14,600	\$14,600	\$17,200
<u>Self-Propelled:</u>				
Locomotives	0	2	2	2
Cab Coaches	0	2	2	2
Trailer Coaches	0	8	8	10
SPPC's	10	4	4	4
Spare Cabs	0	1	1	1
Spare Trailers	0	1	1	1
Spare SPPC's	2	1	1	1
Spare Locomotives	0	0	0	0
Total Cost	\$12,000	\$15,100	\$15,100	\$16,400

NOTE: Any single line implemented alone will require one spare cab coach. The combination of New York service with any of the Boston alternatives will require only one spare cab coach for both lines.

PATRONAGE, OPERATIONAL PLANS, AND REVENUES

Operational plans, 1985 patronage forecasts, and operating costs and revenues are presented for four alternative rail lines from New York and Boston to Cape Cod. Operational plans for each line are developed assuming high utilization of two train sets. Two equipment alternatives are tested, one involving only self-propelled passenger vehicles. Analysis of the impact of passenger and freight rail service track sharing reveals that the two services can coexist without degrading either service.

The patronage analysis identified three key travel markets: tourist, commuter, and nonwork travel. Daily ridership in 1985 to Cape Cod and from Cape Cod combined for each rail line is summarized by travel market in Table 1-3. Annual ridership is summarized below:

1985 DAILY RIDERSHIP BY MARKET AND RAIL LINE  
COMBINED INBOUND AND OUTBOUND\*

Market	Line A			Line B			Line C(1)			Line C(2)		
	MTh.**	Fri.	Sat.	Sun.	MTh.**	Fri.	Sat.	Sun.	MTh.**	Fri.	Sat.	Sun.
Commuter	--	--	--	--	722	722	--	--	432	432	--	--
Nonwork	--	--	--	--	444	444	742	250	196	196	208	72
Tourist												
Peak	312	610	596	726	808	1,572	1,448	1,859	918	1,748	1,489	1,915
Shoulder	166	333	296	380	310	603	555	713	348	679	646	827
Off-Peak	42	126	73	153	98	237	163	339	108	319	189	394
Total												
Peak	312	610	596	726	1,974	2,738	2,190	2,109	1,546	2,376	1,697	1,987
Shoulder	166	333	296	380	1,476	1,769	1,297	963	976	1,307	854	899
Off-Peak	42	126	73	153	1,264	1,403	905	589	736	947	397	466
									2,888	3,418	2,968	2,817
									1,648	2,006	1,783	1,299
									1,370	1,606	1,261	801

**\*\*\*Monday through Thursday.**

**SOURCE: Calculations by Charles River Associates, 1980.**

● Cape Cod to New York (Line A)	70,581
● Cape Cod to South Braintree (Line B)	510,036
● Cape Cod to Boston via Canton Junction (Line C (1))	352,188
● Cape Cod to Boston via South Braintree (Line C (2))	623,203

Line C(2) attracts the greatest ridership due to its having a terminal station in Boston and because of its relatively short travel time. Line C(1) attracts the lowest ridership principally because of its relatively long travel time.

Preliminary schedules of service and average one-way fares for the proposed lines have been determined and are shown in Tables 1-4 through 1-8.

Of the Cape Cod stations, West Barnstable captures the greatest ridership due to its superior accessibility by auto from towns on the western portion of the Cape. Permanent parking space requirements at stations are found to be relatively small for stations on Cape Cod, while temporary vehicle space requirements at Cape Cod stations are considerably larger due to the popularity of the kiss-n-rides mode among commuters and nonwork travelers.

Several marketing or promotional techniques are suggested to increase ridership and utilize equipment more efficiently. These suggestions include the use of special equipment to promote riding by particular market segments, varying fares by time of day and tourist season, and promotional tour and pricing packages.

The impact of rail service on existing bus and auto travel is analyzed. The majority of riders on the Boston service lines (about 70 percent) are diverted from the existing bus service. Because the Boston-Cape Cod corridor is presently well-served by bus, this finding is not surprising. In the New York - Cape Cod corridor, which has relatively little existing bus service, the majority of rail patrons are diverted from auto (about 60 percent of riders).

The impact of an energy shortfall on rail ridership is also calculated. Under a scenario of a 20 percent energy shortfall and white market rationing, commuter and nonwork rail travel would increase almost 10 percent. Tourist ridership from New York and New Haven, however, would decrease about 3 percent as travelers substitute closer destinations or forego vacation travel. Ridership by tourists from Boston and Providence to Cape Cod would increase only about 2 percent, reflecting reduced vacation travel during an energy shortfall.

Operating costs and revenues for each line are shown by season in Table 1-9. All four lines are projected to operate at an annual loss as shown in Table 1-10. The service from New York to Cape Cod is, however, expected to recover operating costs during the peak tourist season (July, August), and produces the minimum annual operating

Table 1-4

LINE A  
NEW YORK -- CAPE COD  
TWO TRAIN SETS

READ DOWN		WEEKDAY SCHEDULE <sup>1</sup>	READ UP	
10:00 am	5:00pm	New York	2:00 pm	9:00 pm
11:35	6:35	New Haven	12:25 pm	7:25
12:55 pm	7:55	Providence ar <sup>2</sup>	10:52	5:52
1:08	8:08	Providence dp <sup>3</sup>	11:05	6:05
2:19	9:19	Buzzards Bay	9:29	4:29
2:48	9:48	Falmouth	9:14	4:14
2:39	9:39	Sandwich	9:19	4:19
2:48	9:48	W. Barnstable	9:10	4:10
3:00 pm	10:00 pm	Hyannis	8:58	3:58 pm

LINE A  
NEW YORK -- CAPE COD  
TWO TRAIN SETS

READ DOWN		WEEKEND SCHEDULE <sup>1</sup>	READ UP	
10:00 am	5:00 pm	New York	2:00 pm	10:00 pm
11:35	6:35	New Haven	12:25	8:25
12:55 pm	7:55	Providence ar <sup>2</sup>	10:52 am	6:52
1:08	8:08	Providence dp <sup>3</sup>	11:05	7:05
2:19	9:19	Buzzards Bay	9:29	5:29
2:48	9:48	Falmouth	9:14	5:14
2:39	9:39	Sandwich	9:19	5:19
2:48	9:48	W. Barnstable	9:10	5:10
3:00 pm	10:00 pm	Hyannis	8:58 am	4:58 pm

<sup>1</sup>The schedule as shown is for New York service alone. Scheduled stations stops at Cape Cod Stations may vary by as much as ten minutes, and in one case one hour, if the New York service is operated in conjunction with a Boston service.

<sup>2</sup>arrive

<sup>3</sup>depart

Table 1-5

LINE B  
S. BRAINTREE -- CAPE COD  
TWO TRAIN SETS (HIGH UTILIZATION)

WEEKDAY SCHEDULE														
READ DOWN							READ UP							
8:45am	10:08am	1:50pm	4:34pm	5:10pm	5:45pm	9:15pm	S. Braintree	7:38am	8:11am	8:30am	12:18pm	1:38pm	5:29pm	8:58pm
8:56	10:19	2:01	4:45pm	5:21	5:56	9:26	Brockton	7:27	8:00am	8:19	12:07pm	1:27	5:12	8:47
9:05	10:28	2:10		5:30	--	9:35	Bridgewater	7:18	--	--	11:58	1:18	5:03	8:38
9:15	10:38	2:20		5:40	--	9:45	Middleboro	7:08	--	--	11:48	1:08	4:53	8:28
9:33	10:56	2:38		5:58	--	10:03	Wareham	6:50	--	--	11:30	12:50	4:35	8:10
9:40	11:03	2:45		6:05	6:34	10:10	Buzzards Bay	6:31	7:29	7:29	11:11	12:31	4:16	7:51
10:09	11:32	3:14		6:34	7:03	10:39	Falmouth	6:16	7:14	7:14	10:56	12:16	4:01	7:36
10:00	11:23	3:05		6:25	--	10:30	Sandwich	6:21	--	--	11:01	12:21	4:06	7:41
10:09	11:32	3:14		6:34	7:01	10:39	W. Barnstable	6:12	7:12	7:12	10:52	12:12	3:57	7:32
10:21am	11:44	3:26pm		6:46pm	7:13pm	10:51pm	Hyannis	6:00 am	7:00am	7:00am	10:40am	12:00pm	3:45 pm	7:20pm

WEEKEND SCHEDULE														
READ DOWN							READ UP							
8:45am	10:08am	1:00pm	3:38pm	6:53pm	8:57pm	10:45pm	S. Braintree	8:28am	9:20am	12:18pm	2:22pm	5:48pm	7:38pm	10:28pm
8:56	10:19	1:11	3:49	7:04	9:08	10:56	Brockton	8:17	9:09	12:07 pm	2:11	5:37	7:27	10:17
9:05	10:28	1:20	3:58	7:13	9:17	11:05	Bridgewater	8:08	9:00	11:58	2:02	5:28	7:18	10:08
9:15	10:38	1:30	4:08	7:28	9:27	11:15	Middleboro	7:58	8:50	11:48	1:52	5:18	7:08	9:58
9:33	10:56	1:48	4:26	7:46	9:50	11:33	Wareham	7:40	8:32	11:30	1:29	5:00	6:50	9:40
9:40	11:03	1:55	4:33	7:53	9:57	11:40pm	Buzzards Bay	7:21	8:13	11:11	1:10	4:41	6:31	9:21
10:09	11:32	2:24	5:02	8:22	10:26	12:09am	Falmouth	7:06	7:58	10:56	12:55	4:26	6:16	9:06
10:00	11:23	2:15	4:53	8:13	10:17	12:00	Sandwich	7:11	8:03	11:01	1:00	4:31	6:21	9:11
10:09	11:32	2:24	5:02	8:22	10:26	12:09	W. Barnstable	7:02	7:54	10:52	12:51	4:22	6:12	9:02
10:21am	11:44am	2:36pm	5:19pm	8:34pm	10:38pm	12:21am	Hyannis	5:50am	7:42am	10:40am	12:39pm	4:10pm	6:00pm	8:50pm

LINEC(1)(via Stoughton)  
 BOSTON -- CAPE COD  
 TWO TRAIN SETS (HIGH UTILIZATION)

1-14

Table 1-7

LINE C(2)(via S. Braintree)  
BOSTON -- CAPE COD  
TWO TRAIN SETS (HIGH UTILIZATION)

READ DOWN				WEEKEND SCHEDULE				READ UP						
8:50am	10:13am	1:20pm	3:13pm	6:15pm	9:00pm	11:00pm	South Station	8:31am	9:46am	12:56pm	2:36pm	5:56pm	7:56pm	10:41pm
9:08	10:31	1:38	3:31	6:33	9:18	11:18	S. Braintree	8:13	9:28	12:38	2:18	5:38	7:38	10:23
9:19	10:42	1:49	3:42	6:44	9:29	11:29	Brockton	8:02	9:12	12:27	2:07	5:27	7:27	10:12
9:28	10:51	1:58	3:51	6:53	9:38	11:38	Bridgewater	7:53	9:03	12:18	1:53	5:18	7:18	10:03
9:38	11:01	2:08	4:01	7:03	9:48	11:48pm	Middleboro	7:43	8:53	12:08pm	1:43	5:08	7:08	9:53
9:56	11:19	2:26	4:19	7:26	10:11	12:06am	Wareham	7:25	8:35	11:50	1:25	4:50	6:50	9:35
10:03	11:26	2:33	4:26	7:33	10:18	12:13	Buzzards Bay	7:06	8:16	11:31	1:06	4:31	6:31	9:16
10:32	11:55	3:02	4:55	8:02	10:47	12:42	Falmouth	6:51	8:01	11:16	12:51	4:16	6:16	9:01
10:23	11:46	2:53	4:46	7:53	10:38	12:33	Sandwich	6:56	8:06	11:21	12:56	4:21	6:21	9:06
10:32	11:55am	3:02	4:55	8:02	10:47	12:42	W. Barnstable	6:47	7:57	11:12	12:47	4:12	6:12	8:57
10:44am	12:07pm	3:14pm	5:12pm	8:14pm	10:59pm	12:54am	Ilyannis	6:35am	7:45am	11:00am	12:35pm	4:00pm	6:00pm	8:45pm

READ DOWN			WEEKDAY SCHEDULE					READ UP						
8:50am	10:13am	1:10pm	4:00pm	5:15pm	5:45pm	10:00pm	South Station	7:23am	8:29am	8:50am	12:56pm	2:26pm	5:15pm	9:36pm
9:08	10:31	1:28	4:18	5:33	6:03	10:18	S. Braintree	7:05	8:11	8:32	12:38	2:08	4:57	9:18
9:19	10:42	1:39	4:29pm	5:44	6:14	10:29	8rockton	6:54	8:00am	8:21	12:27	1:57	4:46	9:07
9:28	10:51	1:48		5:53	--	10:38	Bridgewater	6:45	--	--	12:18	1:43	4:37	8:58
9:38	11:01	1:58		6:03	--	10:48	Middleboro	6:35	--	--	12:08pm	1:33	4:27	8:48
9:56	11:19	2:16		6:21	--	11:06	Wareham	6:17	--	--	11:50	1:15	4:09	8:30
10:03	11:26	2:23		6:28	6:52	11:13	Buzzards Bay	5:58		7:31	11:31	12:56	3:50	8:11
10:32	11:55	2:52		6:57	7:21	11:42	Falmouth	5:43		7:16	11:16	12:41	3:35	7:56
10:23	11:46	2:43		6:48	--	11:33	Sandwich	5:48		--	11:21	12:46	3:40	8:01
10:32	11:55am	2:52		6:57	7:19	11:42	W. Barnstable	5:39		7:14	11:12	12:37	3:31	7:52
10:44am	12:07pm	3:04pm		7:09pm	7:31pm	11:54pm	Hyannis	5:27am		7:02am	11:00am	12:25pm	3:19pm	7:40pm

Table 1-8

PROPOSED RAIL FARES IN THE CAPE COD CORRIDOR  
(in 1980 dollars)

<u>Station</u>	<u>Line A*</u>	<u>Line B**</u>		<u>Line C(1)+</u>		<u>Line C(2)+</u>	
	<u>Cash Fare</u>	<u>Cash Fare</u>	<u>Commuter Fare</u>	<u>Cash Fare</u>	<u>Commuter Fare</u>	<u>Cash Fare</u>	<u>Commuter Fare</u>
Providence	12.95						
New Haven	20.30						
New York City	28.70						
Brockton		1.20	1.11			1.80	1.74
Bridgewater		2.10	2.07			2.70	2.70
Middleboro		2.80	2.78			3.40	3.41
Route 128		3.50		1.40	1.18		
Wareham		3.50	2.68	4.10	3.31	4.10	3.31
Buzzards Bay		3.85	2.93	4.50	3.56	4.50	3.56
Cape Cod		5.20	4.04	5.80	4.68	5.80	4.68

\* Average one-way fares to Cape Cod and Buzzards Bay stations.

\*\* Average one-way fares to South Braintree station.

+ Average one-way fares to South Station.

SOURCE: Calculations by Charles River Associates, 1980.

Table 1-9

WEEKLY AND TOTAL COSTS AND REVENUES BY LINE AND SEASON  
(in 1980 dollars)

Season	Equipment Type	Line A				Line B			
		Revenue		Cost		Revenue		Cost	
		Weekly	Total	Weekly	Total	Weekly	Total	Weekly	Total
Peak	Push-Pull	69,100	621,900	42,100	378,300	56,200	505,800	75,200	676,500
	Self-Propelled	69,100	621,900	47,600	429,000	56,200	505,800	71,800	645,200
Shoulder Peak	Push-Pull	37,900	644,200	40,300	685,600	31,200	531,500	73,200	1,243,800
	Self-Propelled	37,900	644,200	39,400	671,000	31,200	531,500	68,200	1,159,200
Off-Peak	Push-Pull	10,000	260,700	37,900	985,000	21,500	559,600	70,800	1,839,800
	Self-Propelled	10,000	260,700	35,400	918,300	21,500	559,600	65,700	1,710,500
Annual	Push-Pull	--	1,526,800	--	2,048,900	--	1,596,900	--	3,760,100
	Self-Propelled	--	1,526,800	--	2,018,300	--	1,596,900	--	3,514,900

Season	Equipment Type	Line C(1)				Line C(2)			
		Revenue		Cost		Revenue		Cost	
		Weekly	Total	Weekly	Total	Weekly	Total	Weekly	Total
Peak	Push-Pull	60,100	541,600	92,600	833,800	82,800	745,100	99,700	897,800
	Self-Propelled	60,100	541,600	85,700	770,700	82,800	745,100	95,000	855,500
Shoulder Peak	Push-Pull	29,800	507,700	87,300	1,484,100	45,600	776,100	86,300	1,468,000
	Self-Propelled	29,800	507,700	80,100	1,361,900	45,600	776,100	80,000	1,359,400
Off-Peak	Push-Pull	17,300	451,400	83,800	2,178,400	29,700	772,600	86,300	2,245,300
	Self-Propelled	17,300	451,400	76,700	1,995,600	29,700	772,600	80,000	2,079,000
Annual	Push-Pull	--	1,500,700	--	4,496,400	--	2,293,800	--	4,611,000
	Self-Propelled	--	1,500,700	--	4,128,200	--	2,293,800	--	4,293,800

Table 1-10

PROFIT/LOSS BY LINE AND SEASON\*  
(in 1980 dollars)\*\*

<u>Season</u>	<u>Equipment Type</u>	<u>Line A</u>	<u>Line B</u>	<u>Line C(1)</u>	<u>Line C(2)</u>
Peak	Push-Pull	243,600	(170,700)	(292,300)	(152,600)
	Self-Propelled	192,900	(139,400)	(292,100)	(110,300)
Shoulder Peak	Push-Pull	(41,400)	(712,300)	(976,400)	(691,900)
	Self-Propelled	(26,800)	(627,700)	(854,200)	(583,300)
Off-Peak	Push-Pull	(724,300)	(1,280,100)	(1,727,000)	(1,472,700)
	Self-Propelled	(657,600)	(1,150,900)	(1,544,200)	(1,306,400)
Annual	Push-Pull	(522,100)	(2,163,200)	(2,995,700)	(2,317,200)
	Self-Propelled	(491,500)	(1,918,000)	(2,627,500)	(2,000,000)

\* Operating losses are shown in parentheses.

\*\* Rounded off to nearest hundred dollars.

SOURCE: Calculations by Charles River Associates, 1980.

loss. Of the Boston to Cape Cod alternatives, Line B involves the smallest operating loss, its lower revenues being offset by lower operating costs. Line C(2) attracts significantly higher revenues and produces only a slightly larger annual operating loss.

Given the operational plans and associated patronage, operating costs for each equipment alternative are estimated. Operating costs include labor, maintenance, fuel, and capital depreciation. Revenues are also estimated based on projected ridership and assumed rail fares. Table 1-11 summarizes annual ridership, revenues, costs, and deficits for each route.

Table 1-11  
Summary of Estimated Annual Patronage  
and Operating Financial Data

	<u>Patronage</u>	<u>Operating Revenues</u>	<u>Operating Costs</u>	<u>Operating Deficit</u>
Line A	70,581	\$1,526,800	\$2,048,900	\$ 522,100
Line B	510,036	1,596,900	3,760,100	2,163,200
Line C(1)	352,188	1,500,700	4,496,400	2,995,700
Line C(2)	623,203	2,293,800	4,611,000	2,317,200
Lines A & B	580,617	3,123,700	5,809,000	2,685,300
Lines A & C(1)	422,769	3,027,500	6,545,300	3,517,800
Lines A & C(2)	693,784	3,820,600	6,659,900	2,839,300

NOTE: All revenues, costs, and deficit figures reflect the use of push-pull equipment and are stated in 1980 dollars.

#### ENVIRONMENTAL CONSIDERATIONS

An initial assessment has been made of potential environmental issues which would require more thorough examination during subsequent project phases. Principal issues include noise and vibration; air quality impacts, particularly at station sites; and land use impacts, particularly secondary impacts resulting from increased access to and passenger traffic through those communities having stations.

#### COST ESTIMATE SUMMARY

Presented in Table 1-12 is a summary of estimated capital costs for each individual route and for the three New York and Boston alternatives.

Table 1-12

SUMMARY OF ESTIMATED CAPITAL COSTS  
(Thousands of 1980 dollars)

	<u>TRACK</u>	<u>SIGNALS</u>	<u>BRIDGES</u>	<u>STATIONS</u>	<u>LAYOVER AND MAINTENANCE</u>	<u>SUB- TOTAL</u>	<u>EQUIPMENT</u>	<u>TOTAL</u>
Line A: Cape Cod to New York	20,830	1,887	2,449	925	1,090	27,181	9,800	36,981
Line B: Cape Cod to South Braintree	19,959	2,050	2,516	1,554	2,127	28,206	14,600	42,806
Line C(1): Cape Cod to South Station via Canton Junction	28,742	2,916	2,352	1,006	1,090	36,106	14,600	50,706
Line C(2): Cape Cod to South Station via South Braintree	23,818	2,785	14,565	1,554	1,090	43,812	17,200	61,012
Lines A & B: Cape Cod to New York and South Braintree	23,809	2,593	2,731	1,554	2,127	32,814	23,650	56,464
Lines A & C(1): Cape Cod to New York and South Station via Canton Junction	30,794	3,527	2,522	1,006	1,090	38,939	23,650	62,589
Lines A & C(2): Cape Cod to New York and South Station via South Braintree	27,801	3,558	14,780	1,554	1,090	48,783	26,250	75,033

NOTE: Signals include only the minimum system.  
Bridges include only Stage 1 repairs.  
Equipment is push-pull.



